ceive that what was set forth in the first portion of this article will have been abundantly sufficient to disprove the existence of this assumed want of moisture in the Mississippi Valley. If the drift agencies had covered the whole of the prairie States with coarse detritus, as they have the region to the north and northeast; then, in the opinion of the writer, forests would have clothed the whole country, as far west, perhaps, as the western border of Iowa; but from there on, no matter what the condition of the surface, they would not have extended themselves, because of the deficiency of moisture, the decrease being a very rapid one from the 94th meridian towards the west. On the other hand, there is nothing in the geological conditions of the surface in the region of the plains to prevent a forest growth, provided the climatological conditions were favorable, a complete change taking place in the character of the formations soon after we enter Nebraska and Kansas, the Cretaceous and Tertiary rocks covering up entirely all the older strata; and as they consist almost exclusively of coarse arenaceous materials, they furnish by their decomposition a soil very different from that of the prairies. If, again, the topography of the country was such that the warm and moist winds could not blow from the Gulf of Mexico up the valley of the Mississippi, causing as they go an abundant precipitation, then that region would be a sterile one, instead of being, as it now is, one of the most favored agricultural areas of the world, albeit not everywhere clothed with forests.

HYGIENE OF HOUSE PLANTS.

BY GEORGE H. PERKINS, PH. D.

ARE plants growing in occupied rooms injurious or beneficial to the health of the occupants? This is a question often asked and often answered in a very general manner; but it does not seem to be always easy to give specific reasons for a belief in the value or worthlessness of the influence of cultivated plants upon the air immediately about them. As full and satisfactory a reply to the question we have asked as can be given is of considerable importance, now that plants are found growing in a large majority of homes all over the country, and to furnish a reply is the object of this article. Although the writer is conscious that it is not by any means all that could be desired, he yet hopes that it may not be wholly useless to many lovers and cultivators of plants.

A group of plants is so attractive and so interesting in its form and development, that we would gladly be sure that its presence contributes as much to the health of a room as to its beauty. An entirely satisfactory investigation of this matter is scarcely possible, for analyses of air, careful experiments, and observations relating to the influence of plants growing in occupied rooms, are for the most part wholly wanting. The general effect of vegetation in the economy of nature is too wel known to be dwelt upon here. Most are familiar with the fact that animals are dependent upon plants for food, and that after growth, reproduction, and death, the materials of animal structure return to the vegetable, and thus everywhere, in ever-recurring cycles, the dead animal returns to life in the plant; everywhere, for vegetable life is everywhere, rooted in earth, floating in water, buoyed in air, and everywhere attractive, varied, and interesting. What is said in regard to plant life and growth in this article refers only to the higher and flowering plants. Such plants often remove much from both the earth and the air in which they grow, and in return they give much to the air; but while living they return almost nothing to the earth, only now and then a stray leaf or bit of branch. Hence, growing plants tend to change the nature of both soil and air. The chief processes of plant life, absorbing, assimilating, exhaling, are carried on with immense energy. *How* great these forces are we do not yet know, but experiments, such as those of President Clark, of Amherst, have lately been made, which have given us glimpses of the power exerted in vegetable growth. Without direct proof of the fact few would be ready to believe that the outward pressure of sap in a tree could ever equal that of a column of water over eighty feet high; that even in a bit of root wholly severed from the tree, though of course only recently cut off, the force of the sap-pressure could be as great, or that in a squash-vine it could equal that of a column of water nearly fifty feet high. No one, I think, would have supposed that a growing squash in its efforts to increase, would, when confined, lift a weight which was gradually increased to one ton, then to two tons, and finally to two tons and a half. These experiments are so well known that an account of them is unnecessary here, but they tell us very much of the forces acting in vegetation, which are so silent and imperceptible that we too often fail to notice them. In every field of growing grain chemical changes are taking place such as no chemist can produce; forces are in action which, if so directed, could heave

and overturn the soil as by an earthquake. We are learning to look for power in its fullest development, not so much in the more noisy phenomena that all observe, as in those unobtrusive, noiseless processes, unseen save by the eye of science, that go on all about us. In raindrop and snowflake, in forming leaf and opening bud, we are taught to look for force greater than we can know. In the rush of a landslide, as it crushes and overturns everything in its way, all recognize vast power; but all do not know that in the growth of every tree that lies crushed in the pathway of those rock-masses more force was expended than would be needed to hurl them whence they came. It is well known that the leaves of plants exhale moisture, but it is not so well known how much various plants give to the air. The amount varies almost constantly, being affected by temperature, dryness of air, amount of light, and condition of the plant. But the amount of water given to the air during a season by plants, is very considerable. A French botanist found that an oak exhaled in one season eight and a half times as much water as fell in rain over an area equal to that of the leaves. And other similar experiments give similar results.

The well-known process of taking carbonic acid from the air and returning oxygen to it, fixing the carbon in the tissues of the plant, has been shown by Bernard and others to be a true digestive and assimilative process, while all the time a true respiratory process is carried on by which oxygen is taken and carbonic acid given out. During the day, when the leaves are subject to the action of light, both these processes go on, but the assimilative process is vastly the more energetic and conceals the other process wholly. When light is withdrawn the respiratory process comes into prominence, because of the almost or entire cessation of the other, so that the action of plants by night is said to be the reverse of that by day, and so it is practically; but it is to be remembered that the most vigorous and important action of the plant, that which alone exerts any very marked influence upon the surrounding air, is that by which carbonic acid is taken from the air and oxygen given back. The relative activity of these two processes varies at different times of the year, as Corenwinder has shown that when the leaves expand they contain a large proportion of nitrogenous matter, which decreases gradually until autumn, while as the leaves become fully developed the carbonaceous matter increases, at first rapidly, then more slowly, and after a time it remains fixed until towards autumn, when it

decreases. So long as nitrogenous matter is in excess carbonic acid may be given off, but when the carbonaceous matter is in excess, whatever carbonic acid is set free is at once taken up by the chlorophyl and the carbon fixed, the oxygen being set free; and this latter is the great work of plants. So great are its effects that it is believed that they wholly counteract the vitiating influence of the billion pounds of carbonic acid which are, as is estimated, annually sent into the atmosphere; and throughout all the geological ages, since the development of plant life in its higher forms, it has been taking carbonic acid from the air, fixing the carbon and restoring the oxygen. Every pound of coal in all the two hundred thousand square miles of coal area in North America, represents three and two thirds pounds of carbonic acid taken from the air.

It can make but little difference where plants grow; those conditions which are essential to their growth must be met. If forests purify the air about them, it is reasonable to suppose that smaller groups of vegetation in our houses will purify that about them. There are indeed some plants that revel in filth and noisome vapors, but they are not such as will be found in our houses. Modern plants are many of them unable to endure even a slight increase in the amount of carbonic acid in the surrounding air, and we are forced to suppose that the plants of the coal period were peculiarly fitted for the atmosphere in which they grew. It has been found that many gaseous and other substances affect animals and plants in a similar manner, and in many cases an atmosphere in which one will not thrive is hurtful to the other. Many injurious gases that are too often found in our dwellings affect plants even more readily than they do man, so that to a certain extent plants become tests of the air we breathe; and when it is found that plants will not grow in a room because of gas from chandelier or furnace, it is surely true that such rooms are unfit for man's occupation, and that they cannot be used without certain injury to the health. In greenhouses, where a large number of plants are shut up in a small amount of air, it is true that the amount of carbonic acid is, even at night, less than outside. Florists, who spend much of their time in greenhouses, are as a class unusually healthy, and sometimes these people sleep for weeks in the greenhouse, with not the least evil effect. Physicians who have had much experience among florists have uniformly testified to their general robustness. It is also a well-known fact that asthmatic persons often

find great relief as they enter a greenhouse and breathe its air; even those whose complaint prevents comfortable rest elsewhere find little or no trouble in sleeping in a greenhouse. Thus all the facts at our command tend to prove that the air of greenhouses, despite its exceeding dampness, is not unhealthy, but rather the reverse. Luxuriant vegetation growing in very moist air is not *necessarily* so unwholesome as is usually supposed. Mr. Bates, in The Naturalist on the Amazon, speaks of certain localities in which he spent some time, where the air was as if filled with steam at times, and always very full of aqueous vapor, and where the vegetation was wonderfully rank; and yet he found these places unusually healthy, free from many complaints common in drier regions near by. This is perhaps an exception, rather than an example illustrating a general rule, but it is worth some notice.

If house plants are to thrive, they must have abundance of fresh air and sunshine. And now that fine window plants are so generally desired, there is doubtless often a severe struggle in the mind of many a housekeeper, to decide whether the plants shall suffer and perhaps die, or upholstery and carpets be allowed to fade. The plants seem usually victorious, the windows are opened for more pure air, the shutters for more light, and the home becomes more cheery, attractive, and healthful. The air heated by stove, furnace, or worse, by steam-pipes, is almost sure to be very dry, so much so as to be irritating and hurtful to the respiratory organs. As has been noticed, the leaves of plants exhale moisture, often to a considerable amount, and a dry air, if brought into contact with growing plants, is furnished with some of the lacking aqueous vapor. This process is, to a certain extent, self-regulating, for the drier the air the more rapid is the exhalation from the leaves, while this decreases as the moisture of the air increases. Another effect which might have considerable influence upon greenhouse air, but would not amount to much in occupied rooms, where but few plants are kept, is their tendency to equalize the temperature. In most cases plants do not rise in temperature as quickly as does the air about them, and while the air grows warmer during the day, and is at its maximum several hours before sunset, plants go on increasing in temperature for some hours after the air has begun to grow cooler, and thus as the air cools the radiation from plants warms it, while during the day the exhalation of moisture tends to cool the air. Thus far we have considered vegetation only in its ordinary

growth, but after this has continued until the plant has sufficient vigor, it produces flowers and fruit, unless it belong to one of the lower orders. Now the usual conditions may be somewhat changed; the temperature of the plant rises ten or more degrees above that of the surrounding air, and as flowers expand, carbonic acid passes off and oxygen is taken up, but in most cases this is not of such extent as to be important.

A greater effect is that of the odors which some flowers possess. We have very little positive knowledge of the nature of the perfumes of flowers. We know that powerful odors affect some persons unfavorably, at least at the time they are inhaled, causing nausea and faintness. We know that hydrocyanic acid and other deleterious substances exist in some odors, but I believe that all odors from plants which are known to contain injurious substances are disagreeable and repulsive. It seems possible at least that intense odors, such as that of the tuberose or many lilies, if inhaled for a long time would prove harmful, while the more mild odors are not so. There is very good authority for the assertion that many plants, such as the lemon, mint, hyacinth, heliotrope, mignonette, etc., when in bloom, in some way increase the quantity of ozone in the surrounding air, and are in this way beneficial. The common sunflower is said to be very useful in this way, and to do very much to counteract the effect of miasmatic vapors in its neighborhood. Those resinous odors which come from coniferous trees are agreeable to every one, and are generally believed to be wholesome and remedial. The blue-gum (*Eucalyptus*) of Australia emits camphorated and antiseptic vapors which have been found of great value in malarial regions. On the whole it seems probable that the perfumes of most of our house plants are not very powerful for either good or evil, but that they are quite as likely to be beneficial as the reverse. If decaying leaves or other such débris are allowed to remain on the surface of the pots, they may vitiate the air; but aside from this it is not probable that injurious gases can come from decomposing material in the earth of the pots, for the plant and the earth together act vigorously to prevent any such thing.

We conclude, then, that house plants are injurious only as they increase the carbonic acid in the air, and as they give out injurious perfumes. We have found that the first of these effects is certainly far more than counterbalanced by the taking up of carbonic acid and the throwing out of oxygen, and the second is also probably fully neutralized. House plants are positively useful,

as they pour aqueous vapor into dry air, as they demand plenty of light and air, and on this account many a room, otherwise dark and unwholesome, is well lighted and aired. One of the most powerful and important influences of cultivated plants yet remains to be noticed. Thrifty plants are always beautiful, and their growth and development always instructive and interesting; and the constant presence of such objects in our homes is obviously of very great value. We learn to love a favorite plant, and its influence makes our lives gentler and less gross and material; we may not always appreciate this effect, but it is ever acting and ever powerful. Hence, were there no appreciable physical good to come from the groups of plants that are so commonly seen in our windows, this moral benefit should make us encourage in every way their cultivation, and rejoice that it is already so general.

AN ANCIENT SCEPTRE.

BY C. C. ABBOTT M. D.

WHILE the Indians were in undisturbed possession not only of the Atlantic coast of North America, but of a great part, if not the whole, of the interior, they were not politically one people, but divided into many tribes, some of these again being in league, as the Iroquois "nation." These political divisions and subdivisions indicate necessarily the prevalence of rank, and the authority of certain individuals over large and small communities; this again leads to the necessity of badges, or insignia of office. Now among the many relics of the red man that we gather from our fields there occur some specimens which would be veritable puzzles, were it not that we do know something of the past history of the Indians. Among these peculiar forms is that called here a sceptre (Figure 60). These vary much in outline, yet preserve sufficient uniformity to warrant our classifying them as one form.

In many archæological works, and shorter essays on the relics of a circumscribed locality, this exclusively North American pattern is called a perforated ax, a term which for many reasons I believe to be entirely inapplicable; for there has yet to be discovered a single specimen that is adapted to cutting any substance as hard as wood. If any tool, it is a knife for skinning and allied uses; but as an abundant supply of stone implements occur, the world over, that are known to be knives, hatchets,